

CLAIMS

What is claimed is:

1. A method for making a solid state relay, the method
2 comprising the steps of:
 (a) welding ultrasonically a copper foil to a heat sink;
4 (b) soldering a substrate to said copper foil; and
 (c) soldering an output switching element to said substrate;
6 wherein said copper foil increases solder coverage between
said heat sink and said substrate, improving a heat transfer from
8 said output switching element to said heat sink.

2. A method according to claim 1 wherein step (c) is
2 replaced with a new step (c) and further comprises step (d):
 (c) soldering at least one lead frame to said substrate; and
4 (d) soldering said output switching element to said at least
one lead frame.

3. A method according to claim 1 wherein step (a) further
2 comprises the step of:
 welding ultrasonically said copper foil to a non-nickel-plated
4 aluminum heat sink.

4. A method according to claim 1 wherein step (a) further
2 comprises:
 welding ultrasonically a portion of said copper foil to said
4 heat sink in a first pass at between about 0.1 to 1.0 seconds at a
power level of between about 2,000 to 4,000 watts.

5. A method according to claim 4 wherein step (a) further
2 comprises:
 welding ultrasonically additional portions of said copper foil
4 to said heat sink in a plurality of additional passes that are
essentially non-overlapping and parallel until all of said copper
6 foil is welded to said heat sink.

6. A method according to claim 1 wherein step (a) further
2 comprises:

welding ultrasonically said copper foil to said heat sink,
4 wherein said copper foil is about 0.003 inches thick.

7. A method according to claim 1 wherein said at least one
2 lead frame is made from at least a one of copper and nickel-plated
copper.

8. A method according to claim 1 wherein step (b) further
2 comprises soldering said substrate to said copper foil with at
least a one of a solder composition of 60Sn/40Pb, 63Sn/37Pb, and
4 62Sn/36Pb/2Ag.

9. A solid state relay comprising:
2 a heat sink;
a copper foil ultrasonically welded to said heat sink;
4 a substrate soldered to said copper foil; and
an output switching element soldered to said substrate;
6 wherein said copper foil increases solder coverage between
said heat sink and said substrate, improving a heat transfer from
8 said output switching element to said heat sink.

10. The solid state relay according to claim 9 wherein at
2 least one lead frame is soldered to said substrate instead of said
output switching element, and said output switching element is
4 soldered to said at least one lead frame.

11. The solid state relay according to claim 9 wherein said
2 heat sink is made of a non-nickel-plated aluminum.

12. The solid state relay according to claim 9 wherein a
2 portion of said copper foil is ultrasonically welded to said heat
sink in a first pass at between about 0.1 to 1.0 seconds at a power
4 level of between about 2,000 to 4,000 watts.

13. The solid state relay according to claim 12 wherein
2 additional portions of said copper foil are ultrasonically welded
to said heat sink in a plurality of additional passes that are
4 essentially non-overlapping and parallel until all of said copper
foil is welded to said heat sink.

14. The solid state relay according to claim 9 wherein said
2 copper foil is about 0.003 inches thick.

15. The solid state relay according to claim 9 wherein said
2 at least one lead frame is made from at least a one of copper and
nickel-plated copper.

16. The solid state relay according to claim 9 wherein said
2 substrate is soldered to said copper foil with at least a one of a
solder composition of 60Sn/40Pb, 63Sn/37Pb, and 62Sn/36Pb/2Ag.